A feasibility study for small-scale wood pellet production in the Scottish Borders

Sponsors: Borders Machinery Ring, Scottish Enterprise Borders
SISTech, Business Environmental Partnership
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RECOMMENDATIONS

Recommendations and actions to be considered by the project sponsors and partners:

- Present findings to directors of key businesses in established primary and secondary wood-processing businesses, particularly sawmills and joinery businesses.
- Engage with local authorities on the opportunities for wood pellet heating in the Scottish Borders.
- Examine business plans for a range of pellet production scenarios.
- Review successful woodfuel supply chain models in the UK.
- Investigate prices, volumes and specifications for use of wood pellets and woodchips by large power plant and industrial heat and power generators.
- Research the production process and potential markets for wood briquettes as an alternative to wood pellets.

FINDINGS

Pellet manufacture

- Pellet production plant ranges from 50 kg/hr to 30 tonnes/hr capacity.
- A 500kg/h wood pellet line with dryer and bagging equipment can cost around 100,000 EUR installed, while a smaller pellet line starts from around 40,000 EUR. Small pellet presses are available from 6,500 EUR.
- Small producers normally source dry residues from sawmills and secondary processors, while larger producers take wet or seasoned residues from forestry or energy crops.
- Animal feed or grass mills can be used to pelletise wood on a small scale.
- There are about a dozen pellet manufacturers in the UK. A small producer of 3,000 tonnes/yr is to start-up in Aberdeenshire.
- UK production capacity estimates are upwards of 124,000 tonnes per year but would rise significantly with the commissioning of the Balcas plant at Invergordon, Scotland.
- EU wood pellet production in 2006 was 5m tonnes with capacity as high as 7.5m tonnes. Imports amounted to 3m tonnes, with Sweden and Denmark being the main importers.
- There are established quality standards for wood pellets, woodfuel boilers and storage bunkers.
- The costs of sourcing and drying feedstock are critical to the overall production costs.
- The quality and cost of the feedstock, along with the reliability of supply are key considerations for a pellet production business.

Pellet distribution

- There is a wide selection of woodfuel and wood pellet boilers available in the UK, mostly imported.
- There are active supply chain clusters in Wales, the South West of England and Central England supported by local production and demand. One business, the Energy Crops Company, specialises in national wood pellet distribution.
- The members of the Borders Machinery Ring collectively offer a wide range of capabilities, particularly in processing and distribution. In addition, the association offers centralised administrative resources.

Wood sources

- Material suitable for pellet production can either come directly from virgin woodland, or from residues in the secondary wood processing industry
- The Scottish Borders has more than 1,800 privately-owned small woodland holdings, and is a highly promising region for the exploitation of woodfuel from softwood forest residues.
- Softwoods have some advantages over hardwoods for pellet production and use, including greater productivity and higher heat values.
- The harvested supply of virgin timber in Scotland is to increase by one-third to 2020, and continue above present levels thereafter.
- Residues suitable for woodfuel make up about one-half of sawn timber.
- Most sawmill residues are used for paper & pulp, wood-board, animal bedding, compost & mulch and industrial absorbents. This demand for residues presents strong competition to the woodfuel market.
- The supply of wood from energy crops is to increase significantly in response to the demand from regional power plants.

Pellet market

- Modern pellet boilers are reliable, efficient and easy to use.
- The main markets for wood pellets are for combustion in small & medium boilers; and in large boilers which would include co-firing power generators and industrial heat and power plants.
- For fuel and whole life costs, wood pellet systems are highly competitive with heating oil systems while woodchip systems are highly competitive with mains gas and coal systems. Any increases in fossil fuel prices will continue to improve the economics of wood heating in relation to these alternatives. See section 7.5 for assumptions.[1]

Fuel	Fuel cost (p/kWh)	Whole life costs (p/kWh)
Mains gas	2.2	2.3
Electricity	8.2	8.2
Coal	1.1	1.9
Heating oil	4.0	5.4
Woodchips	1.6	1.9
Wood pellets	3.1	4.5

- The principal advantages of wood pellets over woodchips are lower transport and storage costs; uniformity and tradability; and suitability for smaller heat demands. The principal disadvantage is the comparatively high cost of wood pellets. Wood pellets are about twice the cost of woodchips per unit heat energy (3.1p per kWh compared to 1.6p per kWh).
- The high initial costs for woodfuel boilers, along with the lack of awareness and the lack of local fuel supply remain three important barriers to market development.
- In Scotland, the pellet market for small & medium boilers is currently very small, although experience in countries such as Sweden and Austria suggests high potential.
- There are perhaps only 100-200 pellet boiler installations in Scotland at present, with a demand for 500-1000 tonnes/yr pellets, at a market value of £75,000-£150,000 (at £150/tonne). However, some estimates by woodfuel specialists are as high as 600 pellet boilers, equivalent to a demand of 3,000 tonnes/yr pellets in Scotland.
- If 0.4% of all Scottish household off gas-grid systems were replaced with wood pellet heating over five years, this would create a demand of 6,094 tonnes of pellets per year, value £914,100 (at £150/tonne).
- Local authorities could provide a reliable demand for pellets by means of boiler conversions, giving rise to local production and distribution expertise (as experienced in Nottinghamshire and County Durham).
- The market for co-firing wood in power plants as well as industrial heat and power is to grow to more than 1.6m green tonnes/yr in Scotland and the North of England. UK produced pellets may compete alongside imported pellets in this market, but the principal demand will be for locally sourced woodchips from energy crops, woodland residues, sawmills and recycled wood waste.

1 INTRODUCTION

This report describes a feasibility study to establish small-scale wood pellet production in the Scottish Borders region. The main objective is to provide the background information necessary to enable one or more potential pellet producer to set up in business with a good degree of confidence in the viability of the operation.

The study examines the essential elements of the pellet production process, and looks at the supply chain from forest to boiler to ascertain if the market can be sustained and grown through an appropriate network. An assessment of the market going forward is presented in the context of regional, national and European developments. There is a review of wood supply and types of suppliers - sawmill, forest, energy crops and other sources - in the Borders region. Information on specific pellet woodfuel producers and customers illuminates the data. Pellet standards are described, and potential quality problems are highlighted. Key costs associated with pellet production and use are summarised. In addition, the differences between wood pellet systems and woodchip systems are compared and contrasted.

[1] Wood Energy Scotland www.usewoodfuel.co.uk

2 WOODFUEL AND PELLETS

For the wood pellet heating market to grow, customers require local boiler installers and fuel distributors. In South East Scotland there already exist specialist woodfuel boiler suppliers and installers, including for pellet equipment. The nearest pellet producer is in County Durham, and pellets are also sourced from Scandinavia. A local pellet producer is potentially a important advantage, as it would help to keep pellet prices low while providing an important extra measure of confidence to customers that fuel can be obtained from an additional source. Furthermore, pellet users are likely to prefer the lower environmental costs of pellets which have not travelled far from their production location.

Considering the currently limited size of the small and medium pellet boiler market, a new pellet producer in the Borders will have to look at different markets to sustain the business, while the local retail market is given a chance to grow. Key opportunities include the conversion to pellet fuel of old heating systems in schools and other public buildings, and the promotion of pellet heating to the members of the Borders Machinery Ring (BMR). Supply to regional power plants is also a possibility.

Fig 1 Wood pellets[2]

2.1 Pellet stoves and boilers

Pellet stoves for individual rooms range from 5-12kW (from £1,500 ex VAT), while combined stove/boilers start at about 10kW (from about £5,000 ex VAT) and are normally installed in a utility room, out-house or garage. Medium boilers 20-50kW are appropriate for larger buildings. Modern, electronically controlled pellet stoves and boilers are more than 90% efficient, and produce less than 1% ash when fed with high quality pellets. Pellets are metered into the combustion chamber via an auger, where the combustion process burns the pellets in temperatures in excess of 500°C producing emissions cleaner than for fossil fuels. Wood pellets require much less storage space than other woodfuels, but require about three times that space needed for heating oil for the same energy. Old coal boilers can be converted relatively easily to accept wood pellets. The main modification needed is increasing the fuel feed rate to compensate for a lower energy density. One advantage is that the storage and handling infrastructure for a solid fuel will already be in place, although the storage area may need to be enlarged.

[2] www.homeenergy.nl

Fig 2 Estimates of woodfuel demand for different applications[3]

Output (kW)	Application	Oven dried tonnes (odt) per year (0% moisture)	Wood pellets tonnes/yr (10% moisture)	"Seasoned" woodchip tonnes/yr (33% moisture)	Equivalent "green" or "wet" wood tonnes/yr (50% moisture)
5	Stove	1	1.1	Not appropriate	2
15	Family home	5	5.6	Not appropriate	10
350	School	100	111	150	200
1,000	District heating - 200 houses	500	555	750	1000

Notes:
Considering extra heat losses from the evaporation of water vapour, woodchip and green wood equivalent tonnages will in practice be 10-20% higher than the figures given.[4]

A pellet boiler for heating a family home would consume around 5.6 tonnes of pellets over a year (compared to 5 oven dried tonnes/yr equivalent), whereas a school with a 350kW boiler would take around 111 tonnes of pellets (100 oven dried tonnes/yr equivalent).

2.2 Pellets, briquettes and woodchips

Wood pellets are reasonably hard, tan or brown in colour with a sheen and no surface cracks. They are held together by the lignin that makes up to a third of dry wood and provides a measure of waterproofing. Pellet diameters are normally 6 or 8mm, while lengths vary up to 30mm. Pellets with diameters of more than 25mm are classed as briquettes, although cylindrical briquettes are normally 50-100mm in diameter and 60-300mm in length. Because of their size, briquettes cannot be used in pellet boilers or small woodchip boilers. They can be a substitute for coal or logs in many applications, such as domestic fireplaces and stoves, as well as industrial boilers and heating plants.

Fig 3 Comparison of woodchip systems and pellet systems

	Woodchip systems	Wood pellet systems
Fuel availability	Can be readily produced locally	May require significant delivery distances
Fuel quality	Variable – must ensure boiler matches local supply	Standardised and internationally tradable
Capital costs	High capital costs compared to fossil-fuel alternatives	High capital costs compared to fossil-fuel alternatives
Fuel costs	Very competitive – comparable to mains gas	Competitive – comparable to heating oil
Maintenance costs	Moderate	Low
Heat energy MWh/tonne	2-4	5
Energy used in production	Very low	Low
Boilers	Flexible fuel for medium and large boilers. Can accept pellets.	Specific fuel for small boilers. Cannot accept woodchips.
Feedstock	Directly from recently harvested wood or from seasoned wood which has been air dried for months	Best produced from dry wood shavings and sawdust, but woodchips can be used if sufficiently dry
Moisture	<35% - but large boilers can accept higher moisture content	<10%
Ash	Variable	<1% for high quality
Bulk density kg/m^3	175-350	600-700
Production cost	Low	High
Transport and storage	Bulky - high cost	Compact - low cost
Delivery and feed	Frequent deliveries, less convenient	Infrequent deliveries - More convenient

[3]Adapted from Wood Energy Scotland www.usewoodfuel.co.uk
[4] How to estimate recoverable heat energy in wood or bark fuels, Forest Products Laboratory, United States Department of Agriculture, 1979

Wood pellets have various advantages and disadvantages compared to woodchip as described in the table above. One key advantage of wood pellet boiler systems are their relative compact dimensions, particularly for fuel storage, making them much more suitable for smaller buildings. Another is the concentrated nature of the pellets, which mean they can be economically transported over longer distances, and that fewer deliveries are needed. Overall, the pellet user pays more for greater convenience. If woodfuel heating is to develop in Scotland, then wood pellets are a key part of the market, opening it up to those who find a woodchip system unsuitable. Furthermore, if supply is interrupted for a woodchip user, wood pellets remain a convenient temporary alternative, as most woodchip boilers can accept pellets.

For some specific examples of wood pellet and woodchip use, see Appendix D.

3 PELLET MANUFACTURE

3.1 Scale and equipment

Most European pellet production is by large-scale industrial manufacture, often integrated with a large sawmill or heat user. A large line typically produces 5t/hr, although some plants can produce up to 30t/hr. The feedstock - normally wet sawdust or wet or seasoned woodchip - is dried during the production process. Large plants have lower per unit costs compared to smaller plants, but extra transport costs in sourcing feedstock from further away can erode this advantage.

Small producers normally take local dry feedstock – shavings, chips, offcuts, slabwood and recycled wood - which is ground into sawdust. Small-scale pellet machines are available with an output of 200-300kg per hour (see Appendix B for equipment suppliers) but systems as low as 50-100kg/h are also possible. Some producers have more than one pellet line, producing pellets to different commercial and household market specifications.

Animal feed or grass mills can be used to pelletise wood on a small scale. Grass has similar characteristics to wood for pelletisation and as grass mills are used only from April to October they offer an opportunity for small-scale wood pellet production during the winter. This presents the possibility of a more gradual start-up and lower initial capital costs. However, grass and animal feed pelletising equipment has a lower output when pelletising wood and modifications to method and material handling are necessary.

3.2 Production process

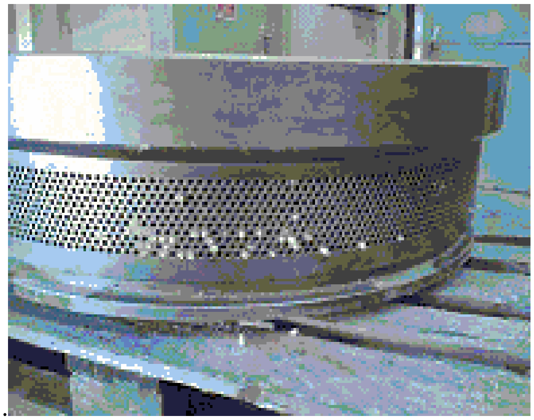
Pre-storage – Storage area for feedstock should be dry and clean. Passive or active drying may take place at this stage
Screening - Raw materials are screened to remove stones, metals and other impurities
Grinding - The material is pulverised in a hammer mill and refined to a consistent fine sawdust. The mill accepts pieces up to 30mm, and grinds to less than 3mm. If the feedstock is rougher a shredder or rotary grinder will need to be used first.
Drying- The sawdust is dried to achieve a consistently low moisture content of 12-15% (additional moisture is removed in the pressing and cooling stage). Most energy is used in drying the sawdust. Large-scale pellet lines process wet sawdust and common batch drying techniques used to dry sawdust are:

- Direct air-drying of sawdust, where hot air is blown through a tube into the centre of a rotating cylindrical drum, radiating heat through the sawdust and driving off the moisture at atmospheric pressure.
- The steam explosion technique, generally a more expensive drying process where wood fibre sawdust is immersed in high-pressure steam to boil off the moisture and condition the fibre before pelletising which releases more natural lignin from within the fibre. This produces pellets brown in colour and results in a better seal with less cracking on the surface and a slight increase in calorific value, a higher bulk density and a reduction of fine dust. It can also improve the production capacity of the pellet press.

Pressing - Milled material is sieved and conveyed to a pellet press, a perforated matrix with a rotating cylindrical roller. The sawdust is compressed under high pressure and forced through the ring or flat die perforations against the resistance of the tapered channels. This is a hot process - in excess of 110°C - that compacts the wood fibre and extracts and bonds the lignin onto the surface of the pellet, holding the pellet in shape and giving it a characteristic sheen on the outside. A knife slices off the pellets at the required length.
Cooling - The pellets leave the machine at around 90°C, and harden when cooled leaving them more robust for storage and handling. Some water is removed bringing the moisture content to below 10%.
Screening – The pellets are passed over a vibratory screen to separate fines.

Bagging - The pellets are bagged automatically in small or bulk bags, or stored in a silo/hopper
Post-storage - Pellets must be protected against moisture. Storage time is unlimited.

Fig 4 Pelletiser die



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Pellets must be able to withstand the mechanical abrasion of transport, loading, filling and storage. The following techniques can improve pellet durability:

- Conditioning the raw material – for example by steam explosion
- Varying the pelletising process - thickness of dies, pressing time, temperatures and pressures
- Adding binding agents - binding additives are commonly used in forage pelletising. Some wood pellet producers add up to 0.5-2% starch as a binding agent. Other producers claim that binding agents are unnecessary. Some possible binding agents are molasses, natural paraffin, plant oil, lignin sulphate (by-product of pulp and paper production, but produces sulphur emissions), spruce or pine bark, and synthetic agents.

In summary, the most important quality aspects of production are:

- The use of good quality, clean, homogenous feedstock
- Careful pre-conditioning - drying, screening and grinding
- Correct die specification

Pellet production is more energy intensive than other woodfuel production, with industry claims that an equivalent 2% of the pellets' own energy content is used in production when using dry sawdust and 15% when using wet sawdust. However, considering power generation inefficiencies- and assuming that 1 odt wood can produce 1MWh electrical energy, or 4.5MWh heat energy – then 8-13% energy is used in pelletising from dry sawdust, 10-25% from wet sawdust and 18-35% from wet woodchip (including drying and crushing).

A number of reported problems with practical pellet production, supply and use are summarised here:

- Wear on the die is higher for hardwood than for softwood. Bark also causes more wear.
- Sawdust can bridge the silo at the augur, so that flow is restricted into the pelletiser.[5]
- High pressure pneumatic filling from tankers can crush the pellets
- Dust and fines can accumulate in delivery tankers leading to delivery problems[6]
- Delivery tankers may lack on-board weighing systems
- Storage bunkers may have non-standard couplings
- Ash content of more than 1% can cause malfunctions after 6-8 hours in small boilers. (Excess ash results in lower energy output and more frequent cleaning of the boiler).[7]
- Excess dust and fines – due to low durability and excess handling of the pellets – can cause problems in small stoves and boilers during charging and combustion. Less than 5% fines should not affect combustion quality. Larger boilers are more tolerant of fines. [8]

[5] Personal communication Fast Forward Energy
[6] As 5
[7] Wood Pellet Europe
[8] As 7

- High moisture pellets take longer to ignite and combust at a lower temperature leading to a build-up of slag and higher emissions.
- Pellets more than 25mm length can cause bridges over the auger entry slot causing the combustion process to stop.

A study of start-up problems in United States pellet plants – resulting in below-target production for 6-18 months – cited a number of causes including: variations in raw material, inadequate design and engineering, use of worn-out or improperly sized equipment, and general inexperience.[9]

As an alternative to pellet production, briquette production requires either a ram-piston press, or a screw extrusion machine. While the briquettes produced by a piston press are completely solid, screw press briquettes have a concentric hole, which gives better combustion characteristics due to a larger surface area, along with higher durability.

Fig 5 Wood briquettes[10]

3.3 Production examples

The following are details of several recent small-scale pellet start-ups in the UK:

Fast Forward Energy, Llandrindod Wells, Wales – Recently established business run by Peter Armishaw using 350kg/h Korte plant, part funded by the Welsh Wood Energy Business Scheme. Takes joinery sawdust and shavings feedstock. Building on local demand particularly in the Welshpool and Machynlleth areas where there is a tie in with boiler installation companies, but also has customers as far as Exeter and Sussex. Regards Ireland as a possible export opportunity.[11]

Scottish woodfuel pellet production trials - in 2007 the first successful production of woodfuel pellets from Scottish raw materials showed that pellet manufacture is technically feasible for a small rural business. Two demonstration plants have been established in the north of Scotland, one in James Jones and Sons Ltd's sawmill using co-product from the mill, and in Norbuild Timber Fabrication and Fine Carpentry. The trials are aimed at promoting small-scale production using locally available materials, and the distribution of wood pellets to a local market.

South West Wood Fuels - 300kg/h pelletiser by Sweden Power Chippers with sawdust and shavings feedstock at Shepton Mallet in Somerset. The system is appropriate for small sawmills and joinery shops.

[9] As 7
[10] www.alibaba.com
[11] Forestry Commission

4 PELLET DISTRIBUTION

There are several options for distribution:

- Directly from production facility to the customer
- To the distributor - often regional boiler installers - and from there to the final customers
- To an exporter, for shipping to Ireland and Europe

One option for distribution is to collaborate with local fuel distributors or forage retailers. While transport costs are not as high as for other woodfuels, delivery distance remains a significant cost, so it is preferable to supply local markets.

4.1 Packaging and transport

In the UK pellets are usually supplied in 12.5-25kg plastic sacks on pallets. For transport from the producer to distributor a 1m3 or one tonne bulk bag is an option. In the United States, small bags for stoves are commonly purchased from filling stations and agricultural supply stores. In Scandinavia, pellets are commonly delivered by tanker and are blown into storage silos or bunkers, which feed into the boiler. This is becoming the main distribution form in Europe.

Fig 6 Wood pellet packaging – small bag, pallet, bulk bag[12]

The main transport options are:

- Flat-bed trailer – suitable for small bags, pallets and bulk bags, but not for loose pellets
- Tipper truck or trailer - good for all pellet loads, and for loose pellets if the bunker or store can accommodate tipped loads. The store can be fully or partly underground with a ramp.
- Pellet tanker or grain or animal feed vehicle – suitable for loose pellets and can deliver pellets pneumatically over 20-30m to a pellet store. The tanker is filled using blower conveyors and transports the pellets to bulk users or to suppliers for bagging and sale to domestic customers
- Container and container lorry - container can be used as a portable fuel store for pellets, but will need modification to ensure good ventilation, ease of filling and extraction.
- Walking-floor trailer - specialist equipment for the delivery of woodchip in bulk. It can be filled quickly and directly from wood chippers.

[12] www.rhpl.co.uk

Fig 7 Pellet delivery tanker[13]

Fig 8 Tanker with on-board weighing system – delivery to storage bunker[14]

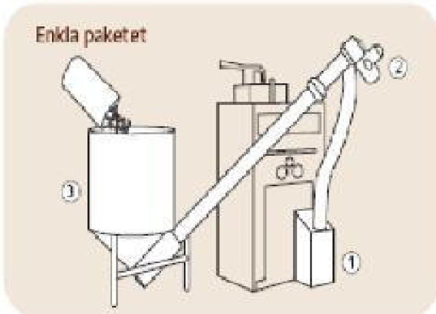
4.2 Storage

The storage of loose pellets at distributors can be in closed sheds or silos. The storage of pellets at customers can be in silos, tanks, bunkers or integral stoves. They can be installed either above or below ground. The storage unit can be purchased off-the-shelf, or can be adapted - such as a hopper or shipping container. A domestic premises requires a 5-6m3 space for wood pellets to fuel the primary central system, to be filled once or twice a year. Poor installation of storage bunkers with poor sealing, badly fitted couplings, and poor filtering of the outgoing air by a dust collector during pressurised filling can present problems. In Austria pellet storage bunkers have specifications for safety, functionality and capacity, with criteria to protect the fuel from water ingress, and allow efficient deposit and extraction. Example safety requirements for a bunker are:

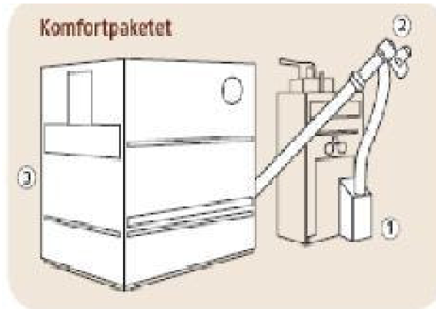
- Solid walls that can withstand the pressure of the pellets
- Protective rubber mat suspended opposite the inlet to the store so that the pellets hit the mat, which absorbs some of the momentum of the pellets, so reducing the possibility of damage to the pellets
- Properly sealing door to the store with removable wooden boards, which allow access when the store is partly full
- No electrical installations other than those required to operate the feed
- Earthed pipes that prevent electrostatic sparks from occurring during loading.
- Completely dry
- Fireproof

[13] www.energy-crops.com
[14] www.silobau-steinecke.de

Fig 9 Pellet storage - mini-silo and pellet storage tank[15]



- mini-silo 1.3 x 0.6 m



- pellet storage tank, 2.5 x 1.5 x 2m

Fig 10 Pellet storage option - internal bag silo[16]

Fig 11 Stove with integral pellet storage[17]

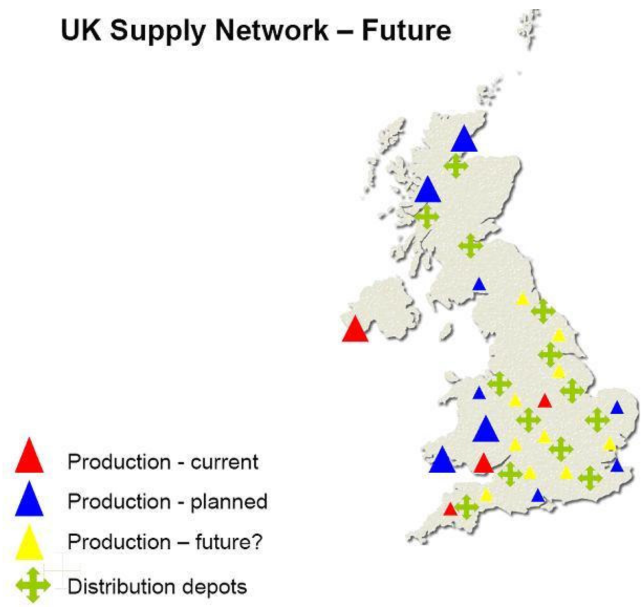
[15] www.statoilpellets.se
[16] www.kwb.at
[17] www.rika.at

4.3 Supply chain examples

For research into woodfuel supply and distribution, the following are some existing supply chain models and associations in the UK:

Wood Energy Business Scheme, Wales - The Wood Energy Business Scheme is a Forestry Commission initiative that aims to establish a network of woodfuel installations across Wales.
South West Wood Fuels, Devon - Agricultural co-operative/ring aiming to increase economic activity associated with the production, processing, promotion, marketing and utilisation of woodfuels.
North East Wood Fuels – Woodfuel producer group in North East England
The Bioenergy Group, East Midlands – an association that aims to increase the use of locally grown biomass for the creation of heat and energy, mainly woodchips and wood pellets.
Caithness and Sutherland - North Highland Forest Trust has conducted a study into a potential supply chain in this area

Fig 12 Energy Crops Company proposed national distribution network for wood pellet[18]



The Energy Crops Company has an expanding wood pellet distribution network. Pellets are delivered bagged on pallets or blown from tankers in loads of 5-30 tonnes. The company collaborates with different pellet producers.

The Borders Machinery Ring at Galashiels may investigate establishing a woodfuel supply chain/cluster using the broad range of resources of the organisation and its members. These capabilities include:

- Wood supply from woodland and coppice
- Timber handling equipment
- On-farm storage and drying areas
- Chippers and hammer mills
- Drying equipment
- Animal or grass feed mills
- Bagging equipment
- Tipper tractors or trucks
- Container trucks
- Walking-floor trailers

[18] www.energy-crops.com

- Tanker, grain or animal feed vehicles to dispense pellets
- Potential pellet customers for heating
- Key personnel to operate the supply chain
- IT support with administrative and billing systems
- Training

5 PELLET MARKET

5.1 Pellet supply

There is an emerging pellet industry in the UK with activity in a number of regions, notably in Northern Ireland, Wales, South West England and Central England.

Fig 13 Estimates of current and planned production for UK pellet producers (where known)

Company	**Location**	**Phone**	**Website**	**Capacity 1000 tonnes/yr**	**Source**	**Notes**
SCOTLAND						
Arbuthnott Wood Pellets	Arbuthnott, Aberdeenshire	01561 320417	www.hotstovies.com	0-3	Woodland	Production from Autumn 2007.
N IRELAND						
Balcas Timber	Enniskillen (and Invergordon, Scotland)	028 663 23003	www.balcas.com	50 (also 100 planned at Invergordon, Scotland)	Sawdust and woodchip from own sawmills	"Brites" pellets
ENGLAND						
Wood Pellet Energy	Chilton, County Durham	01388 72176	www.woodpelletenergy.co.uk	10-20	Recycled wood	Previously part of Premier Waste Management
Manco	East Yorkshire	01430 828660	www.mancoenergy.co.uk	15-20	-	-
Rural Energy	Leicestershire	01664 454989	www.ruralenergy.co.uk	-	Dry sawdust from clean, untreated timber	-
Strawsons Energy	Nottinghamshire	01777 248749	www.strawsonsenergy.co.uk	-	Short rotation coppice	Grower of willow coppice. "Koolfuel" 25, 15, 10, 6mm pellets. Supplies power stations and heat boilers
The Renewable Fuel Company	Barking	07719 544287	www.renewablefuelcompanyuk.com	-	Timber products and forestry residues	-
Bical	Devon	01884 35899	www.bical.net	-	Miscanthus	-
Ecowood Fuels	Devon	01823 680 546	www.ecowoodfuels.co.uk	-	Timber waste	-
South West Wood Fuels	Somerset	01398 324558	www.swwf.info	8-10	-	-
Biojoule	Oxfordshire and Nottinghamshire	01865 207006	www.biojoule.co.uk	10	-	Contract pelletiser with Swedish SPC mobile pellet line. Works with the Energy Crops Company and Coppice Resources

WALES						
Welsh Biofuels	Bridgend	01656 729714	www.welsh-biofuels.co.uk	30-60	Recycled wood, pallets, furniture, sawmill residues and arboriculture	-
Fast Forward Energy	Powys	01597 823835	-	1	Hardwood and softwood timber frame offcuts	Recent start-up
TOTAL	-	-	-	124,000-174,000	-	-

Production capacity estimates point to a range of 124,000-174,000 tonnes per year for wood pellets in the UK. This does not account for some producers in Central England and South West England for which production figures were unavailable. Furthermore, capacity is to increase by a further 100,000 depending on the commissioning of the Balcas plant at Invergordon in Scotland.

5.2 Pellet demand

For the purposes of this analysis, woodfuel boiler sizes are classified as follows:

- Small 5-50kW
- Medium 50kW - 2MW
- Large 2MW - 20MW+

Small and medium demand
Figures for the number of pellet boilers and stoves in Scotland are not readily available. However, there exist some simple estimates for general woodfuel heating. In 2005 the Scottish Executive estimated that there were in the region of 50 woodfuel heat schemes in Scotland with 4.6MW total rating utilising 3000-5000 odt of biomass per year. More recently in 2007, SAOS estimated 8MW of capacity in Scotland for small and very small biomass heat schemes with an additional 90MW capacity proposed to be installed up to the end of 2008.[19] In the Lothian and Borders region including Edinburgh, there are a number of current and planned schemes:

Fig 14 Current and planned woodfuel heating projects in Lothian and Borders region – small and medium

	Installed capacity MW	Fuel	Notes
City of Edinburgh Council	0.36	Woodchips	Fleet maintenance workshop
Queen Margaret University College	1.8	Woodchips	New campus near Musselburgh
Pentland Plants	2.0	Woodchips	From own wood supply
Winton Estate	0.35	Woodchips	From own wood supply
New Borders secondary schools	0.9 est. total	Woodchips	Duns, Earlston and Eyemouth. Supplements conventional fossil fuel boilers
New Borders primary schools	1.2 est. total	Not known	Caddonfoot, Lauder, Halyrude and Kingsland
Scottish Enterprise Borders	Not known	Not known	Working with several businesses considering woodchip boiler installations
TOTAL POTENTIAL CAPACITY	6.6MW (Scottish Borders: 2.1MW)	Mostly woodchips	-
TOTAL POTENTIAL WOOD DEMAND	2,200 odt/yr (Scottish Borders: 700 odt/yr)	Mostly woodchips	-

Assumptions:
Ratio of *capacity (kW) to woodfuel/year (tonnes)* = 3

[19] An overview of the Scottish biofuel market and the barriers to participation by farm businesses, SAOS, 2007

Regionally, woodchip boilers are in operation at Winton Estate and Pentland Plants while Queen Margaret College is installing a boiler on its new campus at Musselburgh. In the Borders there are plans for at least seven woodchip boilers in local schools. Many woodchip boilers can accept wood pellets.

Fig 15 Estimates of annual consumption of woodchips and wood pellets – small and medium systems (based on current and near-term capacity)

	Scotland	**Lothian & Borders**	**Scottish Borders**
Population (m)	5	0.8	0.1
Installed capacity (MW)	up to 98	6.6	2.1
Tonnes odt woodfuel (woodchips and wood pellets) per year	32,700	2,200	700
No. woodchip boilers	100-200	16-32	2-7
No. pellet boilers/stoves	100-200	16-32	2-4
Tonnes pellets per year	500-1000	80-160	10-20
Value pellets per year (£)	75,000 - 150,000	12,000-24,000	1,500-3000

Assumptions:

- 98MW to be installed in Scotland by end of 2008
- Domestic and commercial use only, not industrial scale or co-firing
- Estimated 2,000-3,000 woodfuel installations in the UK[20]. Scotland pro-rata by population total 166-250, assume 100-200 each of woodchip and pellets. Assumes equal numbers of woodchip and pellet systems.
- Average capacity for each pellet stove/boiler 15kW
- Ratio of c*apacity (kW) to woodfuel/year (tonnes)* = 3
- Value one tonne pellets £150
- Excludes the estimated 13,000 tonnes/yr of wood residues combusted in-house by sawmills[21]
- Figures are scaled up or down by population percentages where data is unknown

The table above estimates the current regional and national capacity for small woodfuel and wood pellet systems in Scotland, and relies on a number of broad assumptions. The numbers should be considered as conservative estimates only. In summary, there are perhaps only 100-200 small and medium woodchip boilers in Scotland, along with 100-200 pellet stoves and boilers. For this market, pellet consumption would be in the region of 500-1000 tonnes/yr, as compared with a much greater demand for woodchips (due to the larger boiler sizes and their suitability for commercial applications). However, one Scottish woodfuel boiler specialist offered a estimate of several hundred existing pellet boilers in Scotland, perhaps as high as 500-600.[22] This would suggest an upper estimate of 3,000 tonnes pellets per year.

[20] www.north-dorset.gov.uk
[21] British Timber Statistics 2002, Forestry Commission, 2003
[22] Personal communication with Perthshire Biofuels

Large demand

Fig 16 Current and planned woodfuel users - large

Plant	Location	Capacity MW	Fuel demand wet tonnes/yr	Notes
Cockenzie and Longannet power plants	Firth of Forth	1,200 and 2,400 Up to 5% (60MW, 120MW pro-rata capacity) of the fuel is biomass, and an undefined proportion of this is from imported wood pellets.	-	Both major power stations co-fire imported wood pellets with coal to meet renewable obligations.
Balcas CHP	Invergordon	53	300,000	Also plans to manufacture 100,000 tonnes wood pellets per year.
Scottish Biopower & Tullis Russell CHP	Glenrothes, Fife	50 Also planned are much larger Scottish Biopower plants at Chapelcross and Killoch, Ayrshire, 250MW each plant.	600,000	To supply energy to paper mill.
E.ON Power Plant	Lockerbie	44	480,000	Fuel consisting of 60% green wood from sawmill co-products and small roundwood, 20% short rotation coppice and 20% recycled fibre. A total of 4,500 hectares short rotation coppice willow is to be progressively planted by farmers within a 50-mile radius of the plant.
SembCorp Utilities CHP	Middlesbrough, Teesside	30	300,000	Woodchip, forestry logs, sawmill chip, recycled timber through UK Wood Recycling; and SRC willow within 50mile radius.
UPM Caledonian Paper Mill CHP	Irvine	25	-	Various types of biomass up to 350,000 tonne/yr including the mill's production residues
Tanaris CHP	Fort William	18	-	In collaboration with Alcan. Wood from local forests
Caithness Heat and Power/IEI Energy CHP gasifier	Wick	10	-	Woodchips fuelled district-heating system.
TOTAL POTENTIAL CAPACITY (MW)	-	410-910	-	Includes Cockenzie and Longannet. The lower estimate excludes the two planned 250MW Scottish Biopower plants.
TOTAL POTENTIAL WOOD DEMAND (wet tonnes/yr)	-	-	1,680,000	Where the amounts are known

Co-firing at Cockenzie and Longannet power stations is currently the largest user of biomass fuel in Scotland, and the largest user of wood pellets. The co-firing process combusts crushed pellets with pulverised coal and other biomass such as olive and palm residues. Demand for wood pellets in 2006 by Cockenzie, Longannet and large industrial users was 301,000 tonnes, most of which will have been imported.[23] By April 2009, 25% of co-firing biomass must be sourced from energy crops such as from SRC, rising to 75% by April 2011.[24] Other major existing and potential demand for wood for fuel will come from the paper mills at Glenrothes in Fife (Tullis Russell), and Irvine (UPM) and from the power plants at Lockerbie (E.ON) and Middlesbrough (SembCorp). Additional demand arises from the Tanaris/Alcan plant at Fort William, Caithness CHP gasifier at Wick, and the planned new Balcas sawmill, pellet plant and CHP plant at Invergordon. The total demand is to be in excess of 1.6m wet tonnes per year.

[23] An overview of the Scottish biofuel market and the barriers to participation by farm businesses, SAOS, 2007
[24] The Renewables Obligation (Scotland) Order 2004

5.3 Market opportunities

Fig 17 Market sector opportunities for wood pellets[25]

Sector	**Public or private**	**Pellet boilers**
Householders	Private	Good opportunity in rural and rural fringe areas, off gas-grid, larger houses
Social housing - providers	Public	Good opportunity, woodchip preferred for district heating
Housing - developers and providers	Private	Good opportunity for some developers and providers
Small - schools, offices, leisure centres, care homes, clinics, libraries, community centres, tourist attractions	Public	Good opportunities, where lack of space precludes woodchip boilers. Additionally, pellet stoves can be seen, and are a good demonstration of the environmental values of an organisation.
Large - hospitals, prisons, military	Public	Limited
Farmhouses, estates, guest houses	Private	In line with domestic householders, where woodchip is not preferred, rural and rural fringe areas, off gas-grid
Hotels, care homes, schools, universities	Private	Good potential where woodchip is not suitable due to space constraints
Horticulture	Private	Limited
SMEs, offices, light industrial, retail	Private	Limited
Mining &quarrying	Private	Not suitable
Utilities	Private	Possibilities with electricity generators (including co-firing)
Industrial & Manufacturing	Private	Possibilities with industrial combined heat and power plants
Construction, transport, storage	Private	Not suitable

The table above assesses the diverse potential market sectors for wood pellet boilers and stoves. The most promising small market sectors are rural householders, farmhouses, estates and guesthouses; social housing; private businesses such as hotels, care homes, education; and smaller public sector buildings such as schools and council offices. The public sector is a particularly promising area but there has been little evidence of a move to pellet use by local authorities in the Lothian & Borders region, although there is now adoption of woodchip boilers in new local schools in the Scottish Borders. However, by way of a precedent, more than 70 schools in Nottinghamshire are been converted to pellet use, and in Durham at least six schools have been converted with 15 more planned. These are former coal mining areas with a long experience of working with solid fuels, and so the move to wood based heating is not a radical change. The conversion of old heating systems in Scotland remains a clear opportunity though, especially those that are coal-fired. Some opportunities in specific sectors are:

Small public sector

- Schools, offices, leisure centres, care homes, clinics, libraries, community centres, and tourist attractions – the Scottish Councils: Scottish Borders, East Lothian, West Lothian, Midlothian, Edinburgh City Council and others. Also the English Councils: Northumberland and Cumbria with their district councils.
- Scottish local authorities that are reportedly considering woodfuel installations are Aberdeen City, Aberdeenshire, Angus, Argyll, Ayrshire, Dundee City, Edinburgh City, Fife, Lanarkshire, Midlothian, Perth & Kinross and Stirlingshire.

[25] Adapted from Woodfuel Supply Chains in Scotland, NIFES, 2004

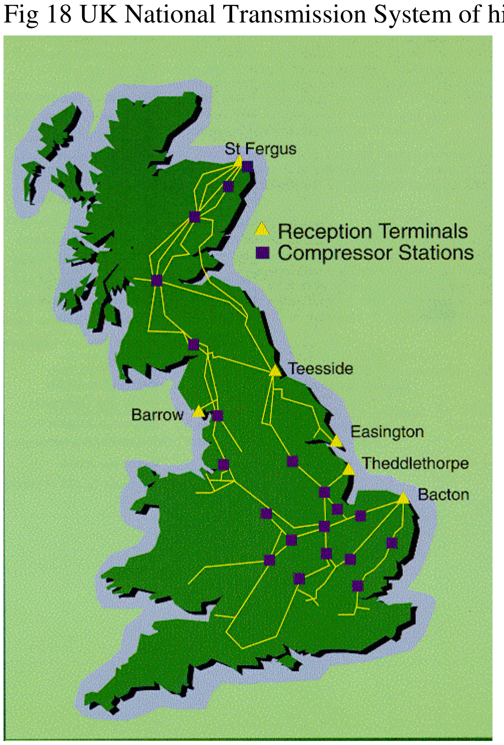
Social housing developers and providers
The Scottish Borders Housing Forum represents social housing providers in the area. The members are:

- Abbeyfield Society for Scotland
- Ark Housing Association
- Berwickshire Housing Association – has an interest in renewable energy with a programme for the deployment of solar/biomass district heating system to mixed tenure housing development at Chirnside.
- Bield Housing Association
- Cairn Housing Association
- Eildon Housing Association,
- Perennial - Gardeners' Royal Benevolent Society
- Hanover Housing Association
- Trust Housing Association
- Link Housing Association
- Margaret Blackwood Housing Association
- Scottish Borders Housing Association
- Scottish Veterans' Garden City Association
- Waverley Housing

Farms and estates
The members of the Borders Machinery Ring are potential customers.

Householders
The outlook for wood pellet demand depends on development in a niche sector of the small boiler market. About 95% of UK households are fuelled by mains natural gas. The off gas-grid remainder has 861,000 oil fired central heating systems and 160,000 LPG fired systems, which have the best potential for replacement with wood pellet boilers. Of these around 10% are replaced each year - 102,100 new systems annually in the UK.[26] In Scotland, the potential is greater, and it is estimated that of 2,192,000 total Scottish homes the proportion of households that have no mains gas supply is greater than one-quarter.

Fig 18 UK National Transmission System of high-pressure gas pipelines[27]



[26] Low carbon heating with wood pellet fuel, XCO2 Conisbee Ltd, Pilkington Energy Efficiency Trust, circa 2001
[27] www.hse.gov.uk

Starting from such a small and uncertain base, it is not possible to extrapolate future predictions of wood pellet installations in Scotland. The following table, though, shows some estimated projections over a five year period.

Fig 19 A projection of wood pellet market penetrations in Scottish households over a five-year period (% of all households) [28]

Market penetration of all households %	**0.05%**	**0.1%**	**0.2%**
Market penetration of all households (number)	1096	2192	4384
Equivalent market penetration of all households "off gas-grid" (%)	0.2	0.4	0.8
Average no. of households adding wood pellet heating per year over five years	219	438	877
Total installed capacity by end of year five (MW)	14	27	55
Yearly energy use (MWh/yr)	15,234	30,468	60,937
Wood pellet equivalent (tonnes/yr)	3,047	6,094	12,187
Annual wood pellet value (£)	457,050	914,100	1,828,200

Assumptions:

- 25% percent of households are off gas-grid
- One tonne of wood pellets equivalent to 5MWh thermal energy.
- Wood pellets at £150/tonne

The table shows possible modest market penetrations for household boiler replacement with pellet boilers, with the resultant installed capacities, energy use and wood pellet demand. If just 0.4% of all household off gas-grid systems were replaced with wood pellet heating over a five year period, this would create a Scottish household demand of more than 6,000 tonnes of pellets a year.

The supply of wood biomass to industrial heat and power plants - including co-firing plants - is a market that cannot be ignored considering its size. Imported pellets are already fired at some plants, but price is key and small pellet producers will find it difficult to compete with industrial scale producers. In 2003, co-firers and large users offered in the range £60-75 tonne for delivered wood pellets.[29] See section 7.2 to compare with production cost estimates.

5.4 International market

Production

EU production in 2006 was 5m tonnes and is predicted to be 6.5m tonnes in 2007, while capacity may be as high as 7.5m tonnes. EU imports are to reach 3m tonnes in 2007 and increase significantly thereafter, with most coming from China, Russia and Canada. Canada is predicted to export 5m tonnes/yr by 2010.[30]

In Sweden, the largest European producer and user, there are more than 30 plants producing an average of 40,000 tonnes/yr of pellets - ranging from 5,000 to 130,000 tonnes/yr – or more than one million tonnes/yr in total. Statoil, a large oil and gas company, has a pellet production business in Sweden with distribution through their petrol stations. The European pellet production ranking by country with the largest producer first is: Sweden, Austria, Baltic States, Germany, Denmark, Poland, Finland, Russia, Italy, France, and Other Europe[31] Pellets from some of these countries are imported into the UK via Port of Blyth (Transped), Teeside (Talloil), Hull and others.

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[28] Adapted from The Commercial Opportunities of Woodfuel Heating in Scotland, Ecoenergy Ltd, 2005
[29] Wood Pellet Manufacture in Scotland, Scottish Forest Industries Cluster, AEA Technology, 2003
[30] www.bioenergyinternational.com
[31] As 30

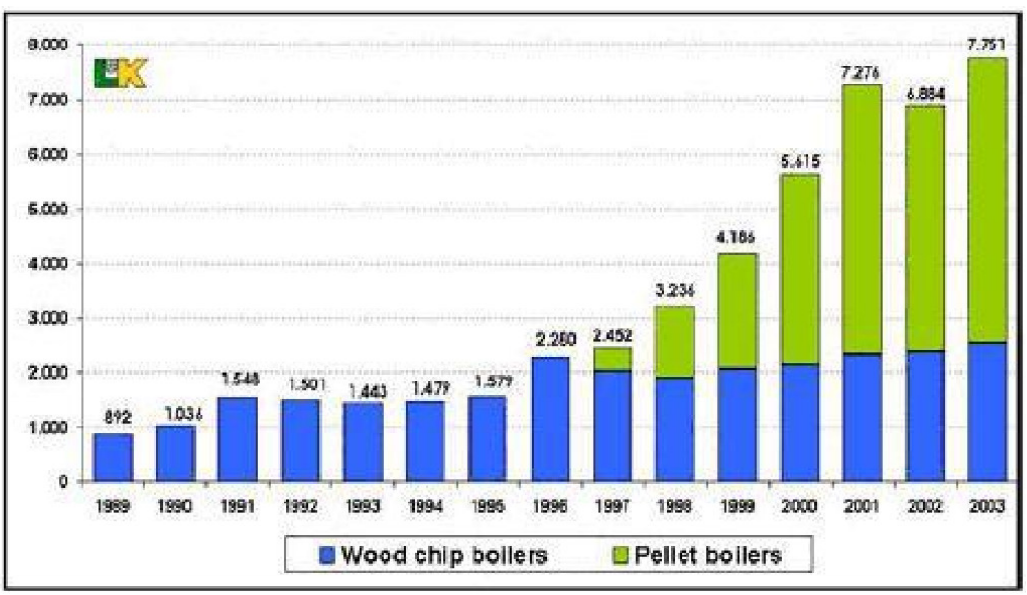
Fig 20 Example imported pellet brands available in the UK

Company	Location	Production Capacity tonnes/yr	Notes
SBE Svensk Brikett Energi	Sweden, Baltic States	500,000	Imported by Renewable Fuels UK (in Scotland) and AW Jenkinson
Vapo	Finland	550,000	Twenty-one plants in Finland, Sweden, Estonia, Denmark and Poland.
Norsk	Norway	-	-

Consumption
In Austria and Germany pellets for household stoves and small boilers represents the main market, while in northern Europe - although the use of small units is becoming more common - most pellets are fired in medium and large scale heating plants. Denmark has seen a very large take up of pellet fuel in the last ten years with current annual consumption of more than half a million tonnes, much of which is imported. Pellets costs in Europe are comparable to, or lower than, light heating oil.

Austria
Austria has all the elements of an active wood pellet market, both in production and consumption. Before 1994, wood pellets were unavailable in Austria, when the Umdasch company began to import pellets from the United States in order to test the market. The response was positive, so the company began pellet production in 1995, and the first Austrian pellet boilers were produced in 1996. Subsidies for boilers were already in place for woodfuel systems, and wood pellet systems were eligible. The subsequent rapid uptake was spontaneous and cannot be explained by any specific policy change. Instead, the experience of woodchip systems - mostly installed by farmers - had established a solid base of technical knowledge and acceptance. This enabled the new fuel to be accepted by customers and exploited by boiler producers, so that woodfuel heating made the jump from farmers to householders. More than 30,000 woodfuel boilers had been installed by 2003, an increasing proportion of which were wood pellet boilers. Austria also has several companies producing technically advanced woodfuel boilers, and is home to more than a dozen pelletising companies, ranging from 300 tonnes/yr up to 37,000 tonnes/yr capacity. In 2006 pellet production exceeded 600,000 tonnes, with domestic demand approximately 400,000 tonnes, and 200,000 tonnes exported. [32]

Fig 21 Evolution of woodchip & wood pellet boiler sales in Austria 1989-2003 (boilers sold per year)[33]



[32] Wood Pellet Heating - Austria, Case Study 13, Renewable Energy Action, Attener, 2004
[33] The Commercial Opportunities of Woodfuel Heating in Scotland, Ecoenergy Ltd, 2005

Export potential
Sweden and Denmark are the main European importers. In 2003 the price range was estimated at £60-75/tonne delivered to these countries.

6 WOOD SOURCES

Wood for pellets can be sourced either from primary sources such as forestry residues, thinnings and short rotation crops, or as co-products from secondary sources in wood-processing industries. These include sawmills and timber frame manufacturers, while reclaimed and recycled wood is another option.

The heating value of the wood depends on the species, the amount of infiltration products in the wood and the amount of moisture present. Different species of oven-dried wood have the around the same average heating value of 5.35 MWh/tonne. Resin has a heating value of about 11 MWh/tonne, so pine, spruce and larch have higher average heating values compared to resin free species. Also, bark has a slightly higher heating value than wood, and bark from softwoods has a higher heating value than bark from hardwoods. However, bark has a high mineral content and produces more ash, making it less suitable for premium woodfuel boilers. With regards to the suitability of wood for pellet production, a study in the United States found that on identical equipment, pelletising softwoods can achieve 20-25% higher manufacturing productivity than pelletising hardwoods. Bark also improves productivity but at the cost of higher ash content.[34]

Fig 22 Evolution of forest wood supply in Scotland 1975-2065[35]

Conifers planted in Scotland on a large scale in the 1960s and 1970s are now approaching maturity, and the chart above shows wood supply continuing to rise to reach a peak around 2020, and remaining above current levels for decades to come. In the Scottish Borders the total woodland area is around 81,000ha with the average woodland size 30ha.[36] Woodland managed by the Forestry Commission accounts for one-third of this, while private woodland makes up two-thirds. The west of the Scottish Borders is characterised by large-scale upland commercial conifer plantations, while the east is characterised by hundreds of small-scale woodlands bordering agricultural land. There are approximately 1,800 privately owned woodland holdings of less than 100ha. An area of 100ha could yield 700 tonnes of woodfuel a year, if producing woodfuel at a sustainable rate of 7t/ha.[37]

In Scotland only around 200ha of short rotation coppice SRC has been planted to date, spread geographically from the Borders to Orkney. Their are proposals for around five times that area, although it will be three to five years before a harvest can be achieved. The currently available harvest is estimated at around 600 odt/year.[38] The local supply of wood from short rotation coppice is also likely to grow significantly, in response to demand from biomass power plants at Lockerbie, Glenrothes and Middlesbrough, as well as the shift to energy crop use by co-firing power plants.

[34] Wood Pellet Europe
[35] Forestry Commission and Forest Research Woodland Surveys
[36] Scottish Borders Woodland Strategy, 2005
[37] In a study for Glasgow City Council it was established that 1,330 hectares of publicly owned woodland was capable of producing 9,310 tonnes (7t/ha) of woodfuel on a sustainable basis
[38] Scottish Executive, 2007

6.1 Primary sources

Woodland and energy crops
Roundwood up to 14cm diameter is too small for sawmill processing, and is therefore available for woodfuel, paper pulping or chipboard manufacture. Other forest residues and thinnings are also suitable for woodfuel. In addition, willow and poplar from short rotation coppicing and forestry are appropriate. Freshly harvested moisture levels are in the region of 50-60%. For "seasoned" woodchip the moisture content is 25-35%, but pellet feedstock requires 12-15%. There are various options for drying - passively or actively - and the choice of drying method will depend on the scale and economics of the business. Given weeks or months, wood and woodchips can be carefully seasoned to less than 35% moisture content using ambient air flow in the forest or a store. However, the moisture content suitable for pellet feedstock will still necessitate a hot air or kiln-drying stage, which may be integrated into the pellet line.

6.2 Secondary sources

Sawmills and wood-processing industry
A major source of clean wood for fuel is the wood-processing industry, which includes primary sawmills, timber frame and furniture industries, wood-board producers and pallet makers. Each source generates wood residues as a co-product of production that have an economic value to the business. Sawdust, woodchips and offcuts produced during these processes make very good woodfuel.

About half the virgin wood processed becomes sawn timber, with the remaining co-products consisting of bark, slab wood, shavings and sawdust. In 2002, 966,000 green tonnes of clean softwood co-product was produced in Scotland. Of this, 13,000 tonnes was used for heating in sawmills.[39] Nearly all co-products already have a market and are diverted for use in the pulp industry, for wood-board manufacture, horticultural mulch, animal bedding, and for industrial spillage absorbents, achieving higher prices than for woodfuel. Consequently, co-product for wood pellets will come from either an increase in sawmill activity or a decrease in other markets for sawmill co-products.

Residues with a high moisture content are a co-product of cutting virgin wood in primary sawmills and are usable as woodfuel in larger power plants and large heating units, whereas residues with a low moisture content result from secondary processing and are suitable as woodfuel for smaller heating units. Kiln-dried material is especially suitable for production of wood pellets.

Sawmills, wood-board producers and other wood-processors are well placed to produce pellets onsite, as they have a reliable supply of residues and can use their own biomass to fire kilns or pellet-line dryers to dry the residues to the required moisture content. As an example of a large operation, Balcas in Northern Ireland runs four sawmills, two large pellet factories and an MDF mouldings plant, and uses surplus sawdust and woodchip from the sawmill to produce combined heat and power. Small sawmills and wood processors are similarly able to kiln-dry using biomass, (although they are less likely to have a CHP unit to produce additional electrical power). A pellet line could be installed alongside a wood-processing business, or alternatively, a portable pellet line could travel to several wood-processors.

Recycled wood
Waste wood from construction and demolition, and from industrial and municipal sources often contain paint, glue, plastic and other contaminants, and is therefore only appropriate as a fuel for large-scale combustion where there are suitable processes and scrubbing equipment to ensure that the emissions standards are met. Wood pallets may be more suitable, but can still be contaminated with paint, dirt and nails. These residues are generally unsuitable for producing premium wood pellets for small and medium boilers.

[39] British Timber Statistics 2002, Forestry Commission, 2003

7 COSTS

7.1 Pellet prices

Wood pellet prices - Current

Fig 23 Retail prices for wood pellets in the UK (ex VAT at 5%) - July 2007

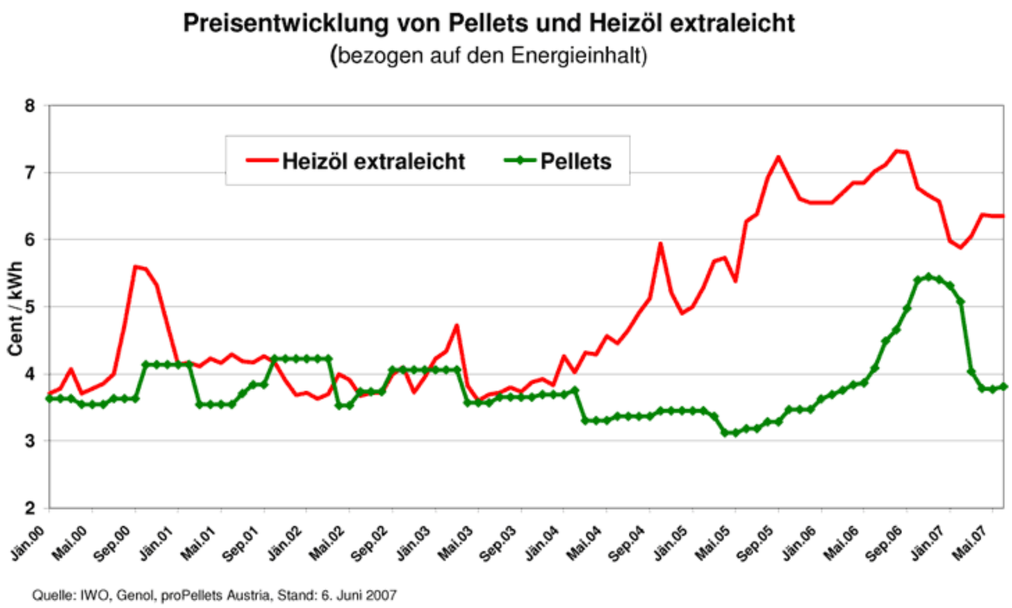
Supplier	Location	Price COLLECTED £		Price DELIVERED £			Notes
		Pallet	Bulk bag	Pallet	Bulk bag	Bulk blown	
Perthshire Biofuels	Dunkeld	175	157	-	-	140	Supplies "Brites" from Balcas in N Ireland
Scottish Biofuel	Alloa	160 (for 832kg, 192 per tonne equivalent)	-	-	-	-	Supplies Vapo pellets from Finland
Eco-Wood Fuel	Devon	-	-	235 England & Wales 250 Scotland & Inner London	198 England & Wales 215 Scotland & Inner London	190 - 230 England & Wales (minimum delivery five tonnes)	Produces and supplies own pellets
Welsh Biofuels	Bridgend	-	130	-	-	-	Produces and supplies own pellets
Fast Forward Energy	Powys	175	160	-	-	-	Produces and supplies own pellets
Manco Energy	East Yorkshire	165	-	35-55 Nationwide Delivery charge	-	-	Produces and supplies own pellets

Notes:
Supplied either on a Pallet (small bags of 12.5-25kg), Bulk bag (builders bag), or Bulk blown (pneumatically from tanker). Prices per tonne, unless otherwise stated

The price range for small bags on a pallet is £165-192 per tonne collected and up to £250 delivered in Scotland and the UK. For bulk bags the price range is £130-160 per tonne collected and up to £215 delivered. A tonne of pellets bulk blown delivered is available from £190-230 in England and Wales

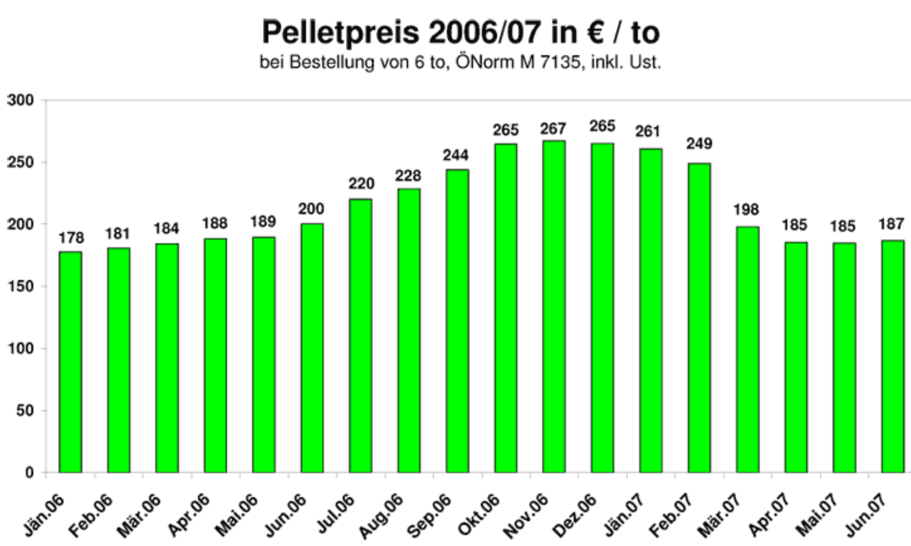
Wood pellet prices – historical

Fig 24 Comparison of wood pellet and heating oil prices in Austria 2000-2007 - per unit energy[40]



Pellet prices and heating oil prices (per kWh energy) in Austria were broadly equivalent and stable from 2000 until 2003. After 2004 the heating oil price increased significantly while pellet prices lagged. Equivalent price information is not available in the immature UK market. However, one study in Lancashire claims that the market value for wood pellets tends to follow and settle at around 80-90% of the price of heating oil for the same energy content.[41]

Fig 25 Pellet prices in Austria 2006-07 (EUR/tonne)[42]



The average price for wood pellets in Austria in 2006-07 was in the region of 200 EUR/tonne, with a range of 178-267 EUR/tonne (£121-181 assuming exchange rate of 0.68).

[40] www.calimax.com
[41] Feasibility Study into the potential for zero carbon villages, Lancashire County Council, Wood Energy Ltd, September 2003
[42] As 40

7.2 Pellet production costs

Capital costs
The cost for a pellet line varies from as low as 40,000 EUR to more than £1m depending on capacity and options such as installation, dryer and bagger. See Appendix B for examples and quotes.
Operating costs
The production costs for wood pellets depend on the costs of feedstock, labour, electricity, drying fuel, capital depreciation and overheads. In a 2003 report for the Scottish Forest Industries Cluster, it was estimated that the total cost for producing pellets in Scotland was £68-73/tonne ex-works[43] (based on operating three shifts, a throughput of 3-5 tonnes/h, and a 20% rate of return on plant capital). Feedstock costs are critical and any reduction can significantly reduce production costs.[44] In comparison, small producers and those operating fewer than three shifts will generally incur higher costs per tonne.

For illustrative purposes, the following is a case study of an Austrian pellet plant, AB Forssjo Bruk.[45]

- Annual turnover 5.5m EUR
- Raw material consumption approx 300,000m3 sawdust per year
- Annual production capacity 45,000 tonnes of wood pellets
- Two wood pellet presses, capacity 7 tonnes per hour
- Bulk distribution 38 metric tonnes/vehicle.
- Bag distribution 42 pallets per vehicle at 832kg/pallet
- Pellet prices bulk delivery: 215 EUR/tonne
- Pellet prices bag delivery: 230 EUR/tonne

Fig 26 Breakdown of pellet production costs - AB Forssjo Bruk case study

	For dry feedstock % of total cost	**For wet feedstock % of total cost**
Raw materials	53	34
Drying	0	30
Staff	20	13
General investment	2	3
Grinding	2	4
Pelletiser	14	9
Cooling	1	0
Storage	4	3
Peripheral	4	4
TOTAL	100	100

In this example for a large pellet plant, the dried raw material accounts for more than half the production cost.

[43] Excluding any cost after the product leaves the factory e.g. delivery charges or retailer profit
[44] Wood Pellet Manufacture in Scotland, Scottish Forest Industries Cluster, AEA Technology, 2003
[45] Forssjo Bruk, 2005

7.3 Feedstock costs

Fig 27 From woodland to sawdust and woodchip - typical costs UK

	Cost £/tonne
Bought standing	2[46]
Bought at roadside	10-13[47]
Chipping process	6-10[48]
Wet woodchips (ex-mill)	10[49]
Wet sawdust (ex-mill)	3-6[50]
High quality woodchip – seasoned (delivered)	40-55 (to 35% MC) [51]
Drying process	up to 7.50[52]
Transport	Variable

Reclaimed wood, which includes joinery shop off-cuts, saw and sanding dust and clean wood waste from processed pallets and demolition timber, can provide a very dry feedstock (8-15% moisture content) for £25-35/tonne, although contamination can be an issue.[53]

7.4 Transport costs

For woodfuel feedstocks, the mean economic road transport distances are estimated as 33-54km for wet forestry residues, 30-60km for willow and 20km for miscanthus.[54] Wood pellets have a high energy density, so are more economic to transport.

7.5 Boiler capital and running costs

Fig 28 Costs of woodchip and wood pellets for heat compared to fossil fuels – small and medium demand [55]

Fuel	**Capital costs (£ per kW)**	**Fuel price**	**Fuel cost (p/kWh)**	**Whole life costs (p/kWh)**	**CO_2 (kg CO_2 per kWh)**
Mains gas	40	-	2.2	2.3	0.19
Electricity	80	-	8.2	8.2	0.97
Coal	200-300	£80/tonne	1.1	1.9	0.29
Heating oil	60-115	38p/litre	4.0	5.4	0.28
Woodchips	110-400	£55/tonne	1.6	1.9	0.025
Wood pellets	280-600	£150/tonne	3.1	4.5	0.025

Notes:
Capital costs are derived from SDC (2005), Rippengal (2005) and experience in Scotland. Capital cost is calculated assuming delivery over a 25-year lifespan of 41,000kWh per kW boiler capacity. Fuel costs are calculated based on local experience. No costs for maintenance, financing or breakdown are included, nor are the effects of climate change levy or potential grants to cover biomass systems. Emissions from electricity assume primary power is coal-fired.

The table above compares capital costs, fuel costs, whole life costs and CO_2 emissions for different fuel types for small and medium boiler systems.

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[46] Woodchip fuel chain – from forest to hopper, Ioannidi, University of Strathclyde, 2002
[47] Forestry Commission
[48] As 47
[49] Wood Pellet Manufacture in Scotland, Scottish Forest Industries Cluster, AEA Technology, 2003
[50] As 47
[51] Memorandum by Forestry and Timber Association, Select Committee on EU, 2006
[52] Comparative costs and returns from short rotation coppice willow, other forestry plantations and forestry residues and sawmill co-products in small-scale heat and power and heat-only systems, Dawson M, Hunter-Blair P, Mullan O and Carson A, 2005
[53] www.swwf.info
[54] Royal Commission on Environmental Pollution
[55] Wood Energy Scotland www.usewoodfuel.co.uk

Capital costs
Woodfuel systems require large storage areas and specialised delivery systems, so the capital costs are higher than for gas or oil systems – between two to five times as large. Often a separate boiler house is needed, whereas gas and oil-fired boilers can be easily integrated into the building being heated. Greater engineering complexity and more moving parts (auger, ash removal) also contribute to higher boiler costs. For example, a 150kW woodchip system – with boiler, accumulator tank and fuel store - would cost around £60,000-70,000 whereas an alternative 170kW oil boiler and tank would cost from £10,000-14,000. Wood pellet systems are generally most costly than woodchip systems per kW

Fuel costs
Woodchips are competitive with mains gas, while wood pellets are competitive with heating oil. Pellets are about twice the cost of woodchips per unit energy (3.1p per kWh compared to 1.6p per kWh).

Whole life costs
The whole life costs for a woodchip system (1.9p per kW) are comparable to those for a mains gas system or a coal system, whereas the whole life costs for a pellet system (4.5p per kW) are competitive with a heating oil system. While the whole life costs for woodchip systems are lower than for pellet systems, the difference is less pronounced for small heating loads of under 30kW.[56]

Maintenance and breakdown
Large woodfuel systems require regular maintenance: while a small woodfuel boiler system requires weekly or monthly attention and an annual service costing a few hundred pounds, systems above about 500kW will also generally need 10-20 minutes attention daily. Breakdown and general repair costs are usually estimated annually at 3% of the capital cost.[57]

CO_2 emissions
Net CO_2 emissions for heating with woodfuels are around an order less than for fossil fuels.

Overall payback period example – woodchip versus heating oil
The capital costs of woodchip-fuelled systems are much higher than for oil but the outlay is quickly recovered through lower fuel costs, assisted by capital grants. *Case study* - Fröling Turbomatic 28kW Woodchip Boiler - cost savings achieved versus the production of heat from an existing 28SEC Oil Central Heating Boiler. Total project cost £14,170, which included an external fuelstore, 500 litre buffer tank and all necessary pipework to link up to the existing boiler, flow and return header in the house. The total grant funding provided from EST, Action Renewables, Clear Skies & NIE Supply was £8,500, giving a total spend of £5,670 (+VAT @ 5%). The boiler allows the building to be heated entirely from woodfuel, therefore saving an annual 5,000 litres of heating oil at a cost of £1,500. The estimated amount of woodchip required is approximately 14 tonnes/year at a cost of £490.The annual financial savings are therefore £1,010. The simple payback period is just under 5.2 years.[58]

[56] Forestry Commission
[57] Woodfuel Supply Chains in Scotland, NIFES, 2004
[58] www.actionrenewables.org

8 APPENDICES

APPENDIX A Standards for pellets and boilers

In the UK there is a voluntary industry Code of General Practice (COGP) for biomass pellets drafted by the British Biogen association. A European standard CEN/TS 14961:2005 recognised by British Standards (BSI) is also in development. A number of European countries have their own national standards, notably Austria, Sweden and Germany. These specifications are compared in the table below, alongside a "typical specification" and the specification for "Brites" wood pellets produced by Balcas - the largest producer in the UK.

Fig 29 Comparison of UK and European wood pellet specifications

	Energy density kWh per kg	**Ash %**	**Bulk Density kg/m3**	**Moisture %**	**Diameter mm**	**Pellet Length mm**	**Sulphur %**	**Chlorine %**	**Origin**
Typical specification	4.7-5.3	0.5-6.0	500-700	5-10	6-12	10-30	-	-	Varied
British Biogen COGP - Premium Domestic	>4.7	<1	>600	<10	-	5-20	<0.03	<0.08	Virgin and clean wood
British Biogen COGP - Premium Commercial	>4.2	<1	>500	<10	-	10-20	<0.03	<0.08	Clean wood waste
Balcas "Brites"	4.8	0.5	650	<10	-	<30	<0.05	<0.04	No bark
CEN/TS 14961:2005 Household[59]	4.7	0.7	-	10	6 & 8	-	0.05	-	Untreated wood without bark

Notes:
CEN/TS 14961:2005 "Example specification for high quality wood pellets recommended for household use" Durability (w-% of pellets after testing) 97.5%, amount of fines (%<3.25mm), additives (% of pressing mass) <2 w-% of dry basis. Only products from agricultural and forest biomass that are not chemically modified are approved to be added as a pressing aid. Type and amount of additive is to be stated.

UK Standards - British Biogen Code of General Practice (COGP)[60]

For biomass pellets – including pellets made from wood - the Code of General Practice[61] specifies the raw materials to produce pellets (under section 8 of the COGP) and their physical and chemical attributes (section 9):
Pellet Raw Materials (section 8) – "The COGP recognises two grades of pellets, Domestic and Commercial. These designations are derived from the nature of the raw materials used in manufacture and from the size of the pellets. British Biogen also recognises that there are Refuse Derived Fuel pellets but these are subject to the Waste Incineration Directive and outside this COGP. The materials used in the manufacture of commercial grade pellets shall be limited to those listed in the draft EU Mandate for European Standards for Solid Biofuels, agreed by the CEN BT/WG 108 Solid Biofuels committee on 15/2/2000. These are:

- Products from agriculture and forestry
- Vegetable waste from agriculture and forestry
- Vegetable waste from the food processing industry
- Wood waste with the exception of: wood waste that may contain halogenated organic compounds or heavy metals as a result of treatment; treated wood originating from building and demolition waste
- Cork waste

[60] British Biogen was the trade association to the UK Bioenergy Industry, now superseded by the Renewable Energy Association.
[61] The British Biogen Code of Good Practice - for biofuel pellets and pellet burning appliances <25kW, 2000

Such material falls outside the Waste Incineration Directive. Commercial pellets may contain no more than 15% material other than biomass. Domestic grade pellets may be made from the above with the exception that the feedstock must be untreated. This COGP acknowledges that CEN is currently forming a new group to consider the question of all "recovered fuels" (such as paper and cardboard) and the outcome of their deliberations may require amendment of Sec 8. Commercial Grade pellets shall not be packaged for sale as a retail domestic product…"
Physical and chemical attributes of pellets (section 9) – "Pellet length shall not exceed five times the diameter. The only additives that may be used in COGP pellets are lignin as a binder and trace amounts of vegetable oil as a die lubricant. The use and amount of any additive shall be disclosed. The amount of ash resulting from burning any fuel must be taken into account in the design of the appliance and all COGP pellets shall be clearly labelled as follows: <1% ash "Premium", <3% ash "Standard", <6% ash "High Ash". Bags or boxes of pellets for retail sale shall be clearly marked - Domestic Grade Biomass (or wood, straw etc as appropriate) Fuel Pellets - and the size and ash content shall be prominently shown. The legend - These pellets conform to the British Biogen Code of Good Practice for Biofuel pellets - shall also appear."

European standards
CEN/TC 335 is the European technical committee developing the draft standard to describe all forms of solid biofuels within Europe, including woodchips, wood pellets and briquettes, logs, sawdust and straw bales. It allows all relevant properties of the fuel to be described, and includes both normative information that must be provided about the fuel, and informative information that can be included but is not required. As well as the physical and chemical characteristics of the fuel as it is, CEN/TC 335 also provides information on the source of the material. Different specifications are required for different fuels, and for pellets and briquettes these include mechanical durability and particle density. Wood pellets are described in CEN/TS 14961 - Annex A – "Examples of specifications for high quality classes of solid biofuels recommended for household usage". The standard is available from the BSI under the name of DD CEN/TS 14961:2005. Also, there are similar specifications for woodchips.

Austria, Germany and Sweden have their own national standards for wood pellets

Austria	ÖNORM M1735 - briquettes and pellets
Sweden	SS 187120 - pellets; and SS 187121 - briquettes
Germany	DIN 51731 - briquettes and pellets

Standards for boilers
There are also standards for biomass boilers. British Standard BS EN 303-5:1999 applies to heating boilers for solid fuels, both hand and automatically fired, with a nominal heat output of up to 300kW. It specifies requirements including performance, efficiency, emissions, thermal output, pressure testing, safety measures and testing.

APPENDIX B Pelletisers and lines– suppliers of plant & equipment

Grants and assistance may be available for capital purchases. See Appendix F for details.

Fig 30 Suppliers of plant & equipment

Company	Country	Website	Notes
Amandus Kahl	Germany	www.akahl.de	1.5-8 t/h.
Minipell	Sweden	www.minipell.com	50 kg/h
Andritz Sprout	Denmark	www.andritz.com	Grinding, pelleting, drying equipment
Pelleting Technology Netherlands	Netherlands	www.ptn.nl	From 3 t/h to more than 30 t/h
Salmatec International	Germany	www.salmatec-park.de	0.5-4 t/h modified machines, also second hand
Larus Impianti	Italy	www.pellet.it	80-1300 kg/h. Manco Energy is UK agent
Sweden Power Chippers	Sweden	www.pelletpress.com	250-500 kg/h. Pelletisers, sack fillers, silos. Used by Biojoule, Nottinghamshire

Olio Technology	France	www.oliotechnology.com	Pelletisers from 3,492 EUR Hammer mills from 1,489 EUR Active dryer of sawdust, woodchips 6,900 EUR
Bühler	Switzerland	www.buhlergroup.com	30 t/h. Also handling and storage
Radviliskis Machine Factory	Lithuania	www.factory.lt	1-3 t/h
God Power	Slovakia	www.alibaba.com	1-10t/h lines from 79,000 EUR
Anyang General International	China	www.alibaba.com	200-500kg/h
Korte	Finland	www.kortteenkonepaja.com	300-800 kg/h. Used by Fast Forward Energy, Wales.
Greenforze (Eko-Diesel)	Sweden	www.greenforze.com	Wide range of plant capacities, complete pellet lines

Fig 31 Greenforze pelletisers – capacities from 75-1,200 kg/h

Model	**EkoPell 100**	**EkoPell 250**	**EkoPell 1000**
Capacity	75-100 kg/h	200-250 kg/h	1,000-1,200 kg/h
Power	7.5 kW	22 kW	75kW
Weight	230 kg	500 kg	-
Size	1,130 x 480 x 920 mm	1,220 x 600 x 1,000 mm	-
Pellets size	6 & 8 mm	6 & 8 mm	6 & 8 mm
Price ex. VAT	6,500 EUR	9,500 EUR	49,000 EUR
Service kit	300 EUR (1-2,000h)	500 EUR (1-2,000h)	26,400 EUR/year for 12h day
			

Fig 32 Greenforze Mobile pellet line - EkoPell Micro Factory 250

EkoPell – Micro Factory 250	
Capacity	200-300 kg/h
Power	22 kW
Gross Weight	3,200 kg
Size	4,000 x 2,100 x 3,000mm
Pellet size	6 & 8 mm
Feedstock	Moisture content 13-18%, 3cm max to hammer mill
Price CIF "Any" Port	39,000 EUR
Dryer 4kW	6,900 EUR

Notes:
Turn-key Micro Size Pellets Pressing Factory built on a steel skid to fit into a 20' FCL container. Includes: hammer mill with 4.5kW motor and a 5mm sieve, cyclone to suck out the sawdust from the hammer mill, screw conveyor to feed the pellets press, pellets press, cyclone to transport pellets to combined cooling/sieving unit, dust filter, return from sieve to pellets press, control panel.

For a complete 500 kg/h Greenforze wood pellet line, including hammer mill, dryer, lubricator, pellet press, screener, and cooler, the cost is 54,000 EUR with 24,000-29,000 EUR for bagging equipment and 10,000 EUR (optional) installation. Delivery in 16-20 weeks. Also available from the same supplier are briquette presses:

Fig 33 Greenforze Briquette Press – EkoBrik 150

EkoBrik 150 Briquette Press	
Capacity	150 kg/h
Power	7.5 kW + 4.5kW
Gross Weight	1,000 kg
Size	1,650x600x1,260mm
Price Ex. EU Port	9,000 EUR

APPENDIX C Boiler installers & suppliers - Scotland & North of England

Fig 34 A number of woodchip and pellet boiler/stove brands available in the UK

Country	Brand
Austria	Okofen Calimax Kohlbach Binder KWB Rika Köb Herz
Germany	Fröling Schäfer Künzel Wamsler Viessman
Sweden	Janfire Ecotec
Finland	Arimax Veto
Denmark	Reka Baxi (woodchip, pellets or grain) Refo (woodchip, pellets or grain) Twin heat (wood pellets, woodchip, grains, sawdust, rape, coal and logs)
Italy	Palazzetti Mescoli ExtraFlame Olivieri Tatano Kalorina (grain, crushed rape and wood pellets)
UK	Talbotts (also small CHP plant) Ashdale

Fig 35 Woodfuel boiler and stove installers, resellers and pellet suppliers

Company	Address	Phone	Website
3GEnergi	Kelso, Roxburghshire	01573 229198	www.3genergi.co.uk
Mercs Energytec/Nuergy	Kirknewton, West Lothian	01506 882720	www.nuergy.com
Highland Wood Energy	Fort William Inverness-Shire	01397 773000	www.highlandwoodenergy.co.uk
Buccleuch Bioenergy	Edinburgh	0131 5240910	www.buccleuch-bioenergy.com
Ian Chappell Boiler Services	Berwick-upon-Tweed, Northumberland	01289 306910	www.igchappell.co.uk
Perthshire Biofuels	Dunkeld, Perthshire	01350 725203	www.perthshirebiofuels.co.uk
Glendevon Energy	Kinross, Fife	01577 840579	www.glendevonenergy.co.uk
Colin McKinlay	Grantown on Spey, Morayshire	01479 873638	-
Peter de la Haye Engineering	Duns, Berwickshire	01361 882929	-
Habitat Heating	Newtonmore, Inverness-Shire	01528 544311	-

Hutchesons of Portsoy	Portsoy, Aberdeenshire	01261 842396	-
Angus Biofuels	Forfar, Angus	01307 466699	-

There are currently few woodfuel boiler specialists in Scotland, reflecting the currently small size of the market.

APPENDIX D Pellet and woodchip user examples - UK

Pellet users

Wood-for-Warmth, Perthshire - Woodfuel supply business in Perthshire, part of a farming enterprise. Wood-fuel boiler to provide heating to farmhouse and adjacent offices. The 50kW Herz boiler can operate on woodchips or wood pellets.

Four heating installations, Angus – Installed by Angus Biofuels, three using pellets and the fourth grain: an office, a nursery school, a retail warehouse and a workshop. Two Calimax Twist 80/20 Pellet Stoves, one Janfire NH Burner and Pellet Boiler from Sweden; one boiler with burner for grain, also from Sweden. Imported fuel from Norsk pellets.

Falstone Tearooms, Falstone Village, Northumberland - Pellet stove and boiler in small tearoom. Palazzetti Freddy Idro 11kW pellet stove/boiler in the main public area, with a Palazzetti Margherita 6.3kW pellet stove for the early morning and during the winter. Annual wood pellet consumption is around four tonnes and the fuel is supplied from a company based in Yorkshire.

Durham schools - Around six Durham schools have been converted from oil and coal to wood pellets. The Council is considering converting up to 15 additional schools. Pellets are sourced inexpensively £58-73/t (reportedly recycled from low quality wood).

Nottinghamshire schools – More than 70 schools are been converted to wood pellets by the council, with a demand of more than 4,500 tonnes/yr. Starting with imported pellets this has provided the foundation for local pellet production to begin at Retford, with the partners being Coppice Resources (SRC willow feedstock), Biojoule (the pellet line) and Energy Crops Company (bagging and distribution).

Woodchip users

North Lanarkshire Council - Four woodchip boiler installations: Fröling Turbomat 500 kW boilers at Taylor High School and Calderhead High School, 220 kW boiler for nursery greenhouses at Drumpelier Park, and a 50 kW boiler for Palacerigg VisitorCentre.

Lochgilphead housing association, Argyll and Bute - 460 kW boiler in a Fyne homes community housing association powered by locally produced woodchips and by-product from a nearby sawmill, heats 50 houses and a respite home.

Kielder Village, Northumberland - Locally-grown chipped wood for a 300 kW Köb boiler. Annual consumption in the range 250-450 tonnes of woodchips.

APPENDIX E Wood-for-fuel sources and suppliers – Borders & region

Primary sources – Woodland

Local searches from www.yell.com, matches closest Galashiels "as the crow flies". The listed businesses are Forestry Services or Consultants

- Wilson G Jamieson, Galashiels
- Henderson Elliot, Selkirk,
- Scottish Woodlands, Newtown St. Boswells
- Robert Gray, Melrose
- Iain M Brown, Innerleithen
- UPM Tilhill Forestry, Jedburgh - Large national forestry and timber harvesting company
- Allanbank Forestry, Kelso
- Ian Johnston Timber Contractor, Haddington, East Lothian
- Tilhill Forestry, Haddington, East Lothian
- Woodland Management Services, Coldstream

Large estates in the region:

- Hearthstanes Estate, Tweedsmuir
- Roxburghe Estates, Kelso
- Lothian Estates, Jedburgh
- College Valley Estate, nr Kirknewton

Other potential suppliers:

Buccleuch Woodlands and Bioenergy, Dalkeith - Supplies wood and installs biomass heating systems. Supplies woodchip to the City of Edinburgh Council, the Estate Office at Bowhill, Selkirk and to Monteith House Nursing Home, Lanarkshire.

AW Jenkinson, Carlisle - Supplies Lockerbie, Teesside and Shotton (UPM paper mill in Wales) biomass plants

Forestry Commission, Cumbria - Largest grower in Northwest England. Delamere, Cheshire and Cumbrian forests. Supplies roundwood suitable for chipping, 75,000 tonnes/yr.

Winton House, Pencaitland, East Lothian - Produces woodchip for own heating use. May supply chips to third parties.

Kielder Forest, Northumberland - Supplies Kielder Village wood burning district heating system.

Primary sources - SRC short rotation coppice and SRF short rotation forestry

A number of SRC projects are in development:

Renewable Fuels, Lockerbie – More than 1000ha of land under contracts or under current application in and around Dumfriesshire, South Lanarkshire and the Borders, Renewable Fuels contracts with growers for SRC supplied to a number of large end-users including E.ON Lockerbie.

Scottish Biofuel, Alloa, Clackmannanshire - Seeking partners from the farming and agricultural community to plant SRC to supply the alternative renewable energy fuel markets.

Chester Wood Nursery, Dalkeith -SRC plantation owned by Scottish Biofuel. May supply Cockenzie, Longannet and Glenrothes power plants.

Coppice Resources, Doncaster - Specialists in all commercial aspects of SRC production including supply of willow cuttings, crop establishment, harvesting and its associated logistics, R&D and the development and supply of dedicated machinery.

Secondary sources - Sawmills and secondary processors

Local searches from www.yell.com. Results for “Sawmill”, matches closest to Galashiels “as the crow flies”

- Agraspark, Longnewton Sawmill, Melrose
- Bowmont Forrest Sawmill, Kelso
- Windymains Sawmill, Humbie, East Lothian
- J.M Scott, Gorebridge Sawmills, Gorebridge, Midlothian
- A & R Timber Products, Woodside Sawmills, Coldstream
- Lothian Trees & Timber, Airfield Sawmill, Dalkeith, Midlothian
- Abbey Timber, The Sawmill, Abbey St. Bathans, Duns
- Chirnside Sawmills Ltd, Duns
- Gosford Timber Products, Gosford Sawmill, Longniddry, East Lothian
- Ford & Etal Estates, Coldstream

Also..

- Oregon Timber Frame, Jedburgh and Selkirk
- J & J Law Sawmill, Lilliesleaf, Jedburgh

Abbey Timber (Duns) and Ford & Etal (Coldstream) are estates with woodland and attached sawmills

APPENDIX F Grants & assistance

Borders Energy Farming Forum
Supporting and developing renewables in the Scottish Borders with pre-feasibility studies, funding guidance, quotations from contractors and contact with previous projects.
www.energyfarming.org.uk

Farm Business Development Scheme
For farmers in Scotland to allow diversification into alternative agricultural production.
www.sled.org.uk/ruralsup.htm

Scottish Forestry Grants Scheme
Grants for schemes using forest residues or material from woodland being brought back into active management. Also for short rotation coppice.
www.forestry.gov.uk

Bio-energy Infrastructure Scheme
To develop supply chains from woodfuel source to end user via the establishment of 'Producer Groups'. Applies to energy crops and forestry woodfuel. Growers, farmers, woodland managers. Not Scotland.
www.defra.gov.uk/farm/acu/energy/infrastructure.htm

Bio-energy Capital Grants Scheme
Investment support for schemes struggling to compete in the Renewables Obligation. Geared towards energy crops schemes although support is also available for heating schemes.
www.dti.gov.uk/energy/renewables/support/capital_grants.shtml

Scottish Biomass Support Scheme
Supporting rural economies by creating sustainable green jobs. For infrastructure directly related to developing the woodfuel/biomass supply chain.
www.usewoodfuel.co.uk/ScottishBiomassSupportScheme.stm

Loan Action Scotland
Allows a business to borrow between £5,000 and £100,000 interest-free, repayable up to 4 years, to help a business to reduce its energy consumption.
www.energysavingtrust.org.uk

Enhanced Capital Allowance Scheme
Tax benefits to encourage businesses to invest in low carbon, energy-saving equipment.
www.eca.gov.uk

Scottish Community and Householder Renewables Initiative
Grants, advice and project support for new community and household renewable schemes in Scotland.
www.est.org.uk/housingbuildings/funding/scotland

Low Carbon Building Programme
For householders and community organisations. Overall maximum of £1,500 or 30% of the relevant eligible costs.
www.lowcarbonbuildings.org.uk

Carbon Trust Biomass Accelerator Project
Focus on making small scale biomass self sustainable by reducing costs, supply chain risks and raising awareness.
www.carbontrust.co.uk/technology/technologyaccelerator/biomass.htm**.**

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Logpile woodfuel advice	www.nef.org
Woodfuel training courses	www.ruraldevelopment.org.uk

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Wood recycling, Waste Resources Action Group www.recyclewood.org.uk

Associations and groups

Renewable Energy Association	www.r-e-a.net
Timber Frame Association	www.timber-frame.org
Confederation of Forest Industries	www.confor.org.uk
Sawmillers Forum	www.south-scotland-sawmillers.org
Scottish Agricultural Organisation Society	www.saos.co.uk
Forestry Stewardship Council	www.fsc.org
Scottish Borders Forestry Action Group	www.bordersforesttrust.org
Forestry and Timber Association	www.forestryandtimber.org
Renewable Energy Growers	www.energycrop.co.uk.
NE England Forestry products portal	www.neforestry.info
Scottish Forest Industries Cluster	www.forestryscotland.com
The North Sea Bio Energy Project	www.northseabioenergy.org
Scottish Borders Housing Forum	http://housing.scottishborders.gov.uk
Wood Energy Business Scheme, Wales	www.woodenergybusiness.co.uk
North Highland Forest Trust	www.nhft.org.uk
Action Renewables	www.actionrenewables.org
The Bioenergy Group	www.bioenergygroup.org

Companies

Buccleuch Woodlands and Bioenergy	www.buccleuch-bioenergy.com
AW Jenkinson Forest Products	www.awjenkinson.co.uk
Winton House	www.wintonhouse.co.uk
Kielder Forest	www.kielder.org
Hearthstanes Estate	www.hearthstanes.com
Roxburghe Estates	www.roxburghe.bordernet.co.uk
Lothian Estates	www.lothest.co.uk
College Valley Estate	www.college-valley.co.uk
Fountain Forestry	www.fountainsplc.com
Tilhill Forestry	www.upm-tilhill.com
Buccleuch FBR	www.fbr.co.uk
Scottish Biofuel	www.scottishresourcesgroup.co.uk
E.ON	www.eon-uk.com
SembCorp	www.sembutilities.co.uk
Coppice Resources	www.coppiceresources.com
UK Wood recycling	www.ukwoodrecycling.co.uk
Tanaris	www.tanaris.com
Balcas	www.balcas.com
South West Wood Fuels	www.swwf.info
Energy Crops Company	www.energy-crops.com
Renewable Fuels	www.renewablefuels.co.uk

Glossary

odt	oven dried tonnes (0% moisture content)
SRC	short rotation coppice
SRF	short rotation forestry
CHP	combined heat and power
MC	moisture content

10 PROCESS CHARTS

Chart 1 Wood co-products and residues flow

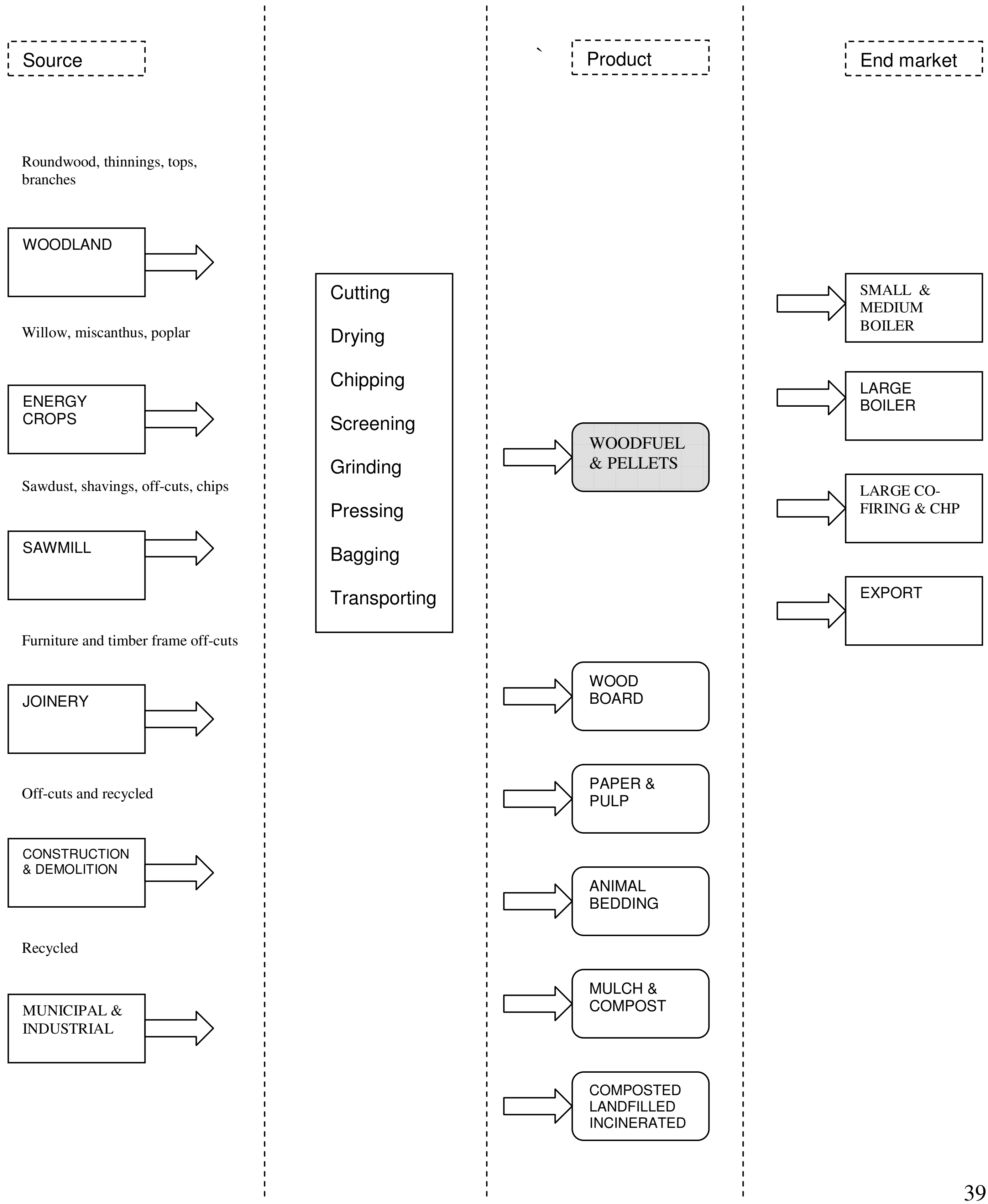

Chart 2 Process flow for wood pellet production